OXFORD

INTERNATIONAL
AQA EXAMINATIONS

Please write clearly in block capitals.

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OXFORD AQA INTERNATIONAL AS
BIOLOGY (9610)

Unit 1 The diversity of living organisms

Monday 14 January 2019 07:00 GMT Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a ruler with millimetre measurements
- a scientific calculator, which you are expected to use where appropriate.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- All working must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
TOTAL	

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

Answer **all** questions in the spaces provided.

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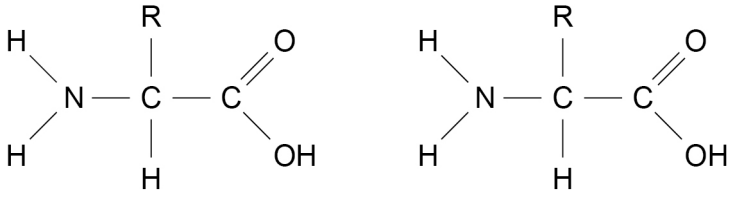
0 1 **Figure 1** shows the general structural formula of two amino acids.

Figure 1



Amino acid 1 **Amino acid 2**

0 1 . 1 During a condensation reaction the two amino acids join to produce a dipeptide.

Draw the structural formula of the dipeptide.

[2 marks]

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0 1 . 2 Polypeptides contain many peptide bonds. Some enzymes hydrolyse peptide bonds between amino acids and this digests the polypeptide. How much polypeptide has been digested is called the degree of hydrolysis (DH). The DH value may be calculated from the equation:

$$DH = \frac{100 \times \text{Number of peptide bonds hydrolysed}}{\text{Total number of peptide bonds present}}$$

Insulin is a protein made of two linear polypeptide chains. Chain A consists of 21 amino acids and chain B of 30 amino acids.

A molecule of insulin's chain A is digested by insulin-degrading enzyme (IDE). The DH value of the digested insulin is 70

Calculate how many peptide bonds have been hydrolysed.

[2 marks]

Peptide bonds hydrolysed = _____

0 1 . 3 Describe a biochemical test to show that insulin is a protein.

[2 marks]

_____

_____

_____

_____

_____

_____

Question 1 continues on the next page

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0 1 . 4 Name the level of protein structure used to describe that insulin has two chains of amino acids, chain A and B.

[1 mark]

Tick (✓) **one** box.

Primary structure ☐

Secondary structure ☐

Tertiary structure ☐

Quaternary structure ☐

0 1 . 5 Explain how a change in the primary structure of IDE may result in a different three-dimensional structure.

[3 marks]

10

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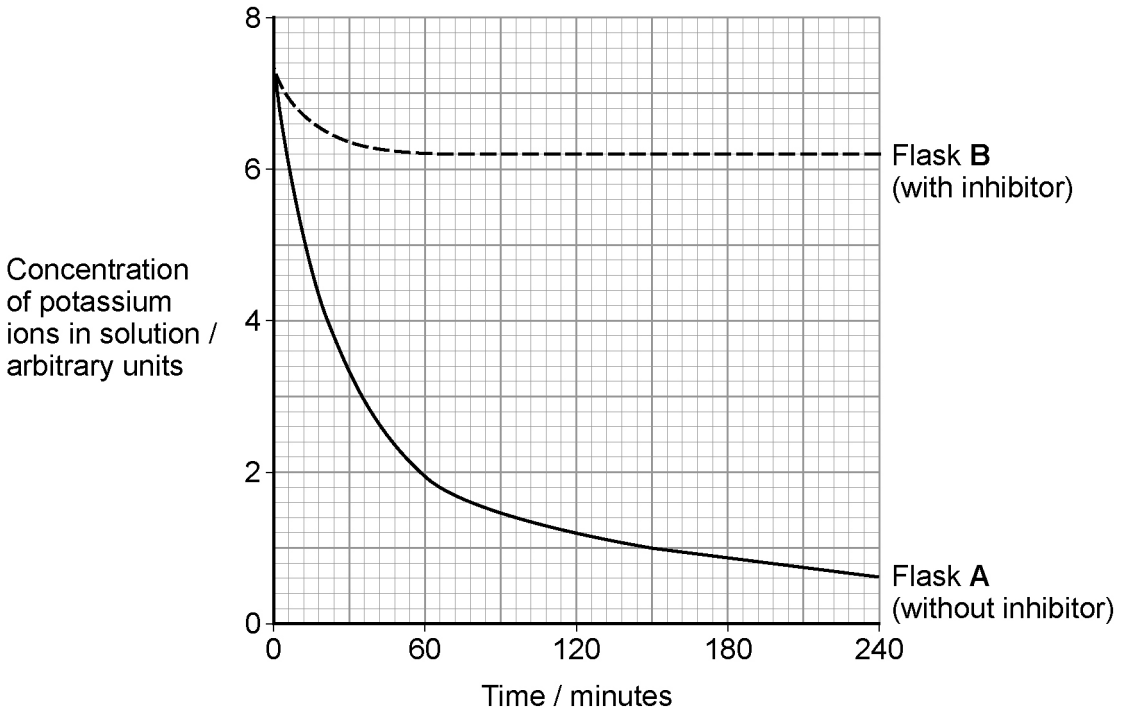
0 2 A student investigates the uptake of potassium ions by pea plants.

The student:

- uses two flasks, **A** and **B**
- adds equal volumes of a solution containing radioactive potassium ions to each flask
- adds a sample of the roots of a pea plant to each flask
- adds a solution of a respiratory inhibitor to flask **B** and the same volume of water to flask **A**
- measures, at regular intervals, the concentration of potassium ions **remaining** in the solution in each flask.

Figure 2 shows the results from the investigation.

Figure 2



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0 2 . 1 Calculate the **mean rate of uptake** of potassium ions by the roots of the pea plant in Flask **A** from 0 to 30 minutes.

Give your answer to three significant figures.

[2 marks]

Mean rate of uptake = _____ Arbitrary units minute^{-1}

0 2 . 2 Explain the decrease in the concentrations of potassium ions in **each of the two solutions** from 0 to 30 minutes.

[3 marks]

Question 2 continues on the next page

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0 2 . 3 The curve for Flask **B** levelled off after 60 minutes.

Explain why.

[2 marks]

0 2 . 4 The inhibitor used in Flask **B** is malonate. Malonate has a very similar structure to succinate. Succinate is the usual substrate of the enzyme succinate dehydrogenase. This enzyme catalyses an important reaction in respiration.

Explain how malonate inhibits respiration.

[2 marks]

9

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0 3 A scientist investigates the red blood cell counts in similar human populations living at different altitudes above sea level. The scientist chooses 100 people in each sample.

Table 1 shows the results.

Table 1

Altitude above sea level / metres	Mean red blood cell count / cells dm^{-3} blood
0	5.1×10^{12}
1000	5.3×10^{12}
2000	5.6×10^{12}
3000	5.8×10^{12}
4000	

0 3 . 1 The total mean red blood cell count **from** 0 **to** 4000 metres above sea level was 5.54×10^{12}.

Calculate the mean red blood cell count **at** 4000 metres above sea level.

[1 mark]

Mean red blood cell count = _____ cells dm^{-3}

0 3 . 2 The mean red blood cell count values are given in standard form.

Explain why.

[1 mark]

_____

_____

_____

Turn over ►

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0 3 . 3 The scientist chooses five samples, each of 100 people.

Give **two** variables the scientist should control when choosing the samples.

[2 marks]

1 _____

_____

2 _____

_____

0 3 . 4 There is less oxygen at high altitudes than at sea level. People living at 4000 metres above sea level have more red blood cells than people living at sea level.

Explain why having more red blood cells at 4000 metres is an advantage.

[2 marks]

_____

_____

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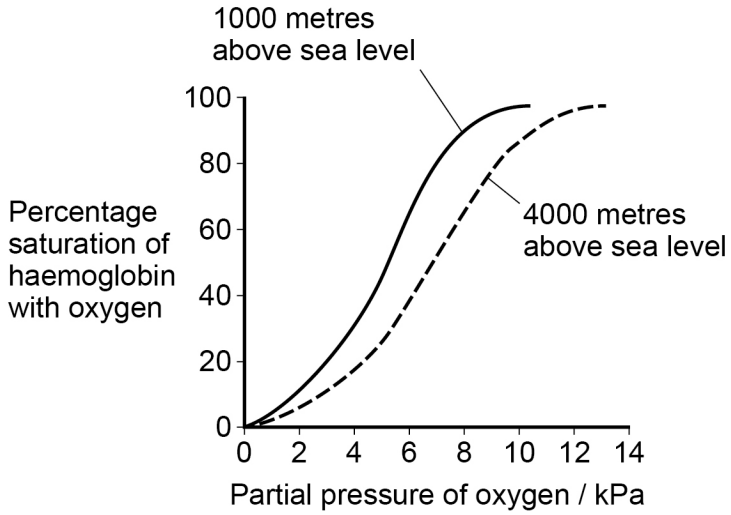
Figure 3 shows oxygen dissociation curves for the people living at 1000 metres above sea level and the people living at 4000 metres above sea level.

Figure 3



0 3 . 5 Explain the advantage to the people living at 4000 metres above sea level of having the oxygen dissociation curve shown in **Figure 3**.

[4 marks]

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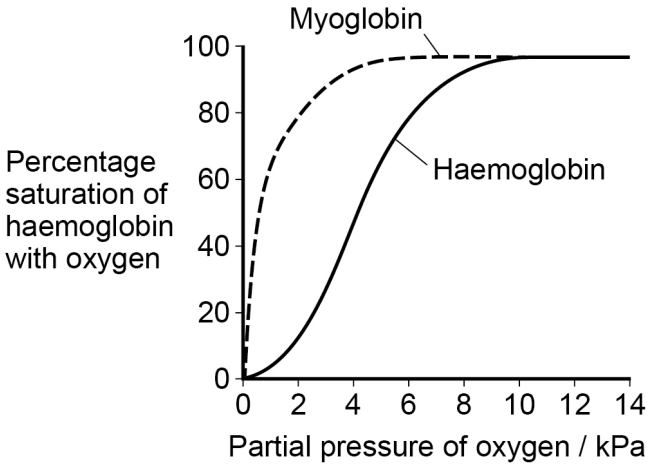
Myoglobin is a protein found only in muscle cells. Myoglobin and haemoglobin both bind to oxygen. The partial pressure of oxygen in a muscle is 4kPa.

Figure 4 shows oxygen dissociation curves for haemoglobin and myoglobin.

Figure 4



0 3 . 6 Suggest an advantage to a muscle cell of the curve for myoglobin being different from the curve for haemoglobin.

[1 mark]

11

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0 4 A scientist investigates the diversity of insects in three different habitats:

- a barley field containing one crop
- a wheat field containing one crop
- a meadow containing many different plants.

Table 2 shows the results.

Table 2

Insect species	**Number of individuals of each insect species in each habitat**		
	Barley field	Wheat field	Meadow
Aphis fabae	32	4	0
Macrosiphum rosae	78	0	1
Lasius niger	0	126	2
Polyommatus Icarus	0	5	12
Arctia caja	0	0	8
Palomena prasina	0	0	9
Apis mellifera	0	25	3
Vespa crabro	0	10	3
Coccinella septempunctata	0	0	2
Pyrrhosoma nymphula	0	0	5
Staphylinus olens	86	56	0
Carabus violaceus	0	0	7
Species richness	3	6	10
Total number of insects	196	226	52
Index of diversity		2.60	7.85

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0 4 . 1 What is meant by species richness?

[1 mark]

0 4 . 2 Use the data in **Table 2** to calculate how many times greater the index of diversity of the meadow is than the index of diversity of the barley field.

$$d = \frac{N(N-1)}{\sum n(n-1)}$$

[2 marks]

Answer = _____ times greater

0 4 . 3 The barley field was left for five years and developed into a meadow. The scientist noted an increase in biodiversity of **birds** in the area.

Explain this increase.

[3 marks]

6

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0 5 A student uses potato cylinders to investigate the effect of sucrose concentration on the uptake and loss of water from plant tissue.

The student:

- makes five dilutions of sucrose solution using a 1.0 mol dm^{-3} sucrose solution and distilled water
- cuts five cylinders from a potato, blots them dry and weighs them
- puts each cylinder in a different concentration of sucrose solution for 24 hours
- removes the cylinders from the sucrose solutions, blots them dry and weighs them.

Table 3 shows the student's results.

Table 3

Concentration of sucrose solution / mol dm^{-3}	Percentage change in mass of the potato cylinders
0	+5.8
0.2	+2.5
0.4	−6.1
0.6	−18.1
0.8	−25.2
1.0	−25.5

0 5 . 1 Describe how the student could use the 1.0 mol dm^{-3} sucrose solution to make 25 cm^3 of 0.2 mol dm^{-3} sucrose solution.

[1 mark]

0 5 . 2 Why did the student blot the potato cylinders dry before weighing them?

[1 mark]

Do not write outside the box

0 5 . 3 The student left the potato cylinders in the sucrose solution for the same length of time.

Suggest **two** other variables the student controlled.

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

0 5 . 4 Describe how the student calculated the percentage change in mass of a potato cylinder.

[1 mark]

_____

_____

_____

0 5 . 5 Why did the student calculate the **percentage** change in mass of the potato cylinders instead of just the change in mass?

[1 mark]

_____

_____

_____

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0 5 . 6 Describe how the student could use the results in **Table 3** to find the sucrose concentration that is in equilibrium with the solution in the cells of the potato tissue.

[2 marks]

0 5 . 7 Explain the change in mass of the potato tissue in the 0.2 mol dm^{-3} sucrose solution.

[2 marks]

10

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0 6 Biological classification uses a hierarchy to arrange species in groups.

0 6 . 1 What is each group in a biological classification called?

[1 mark]

0 6 . 2 What is the largest group in a biological classification called?

[1 mark]

Question 6 continues on the next page

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0 6 . 3 **Figure 5** shows two dogs, a Chihuahua and a Great Dane.
All dogs are members of the same species.

Figure 5

Chihuahua **Great Dane**

A species may be defined as a group of organisms capable of interbreeding and producing fertile offspring.

Suggest the difficulty with using this definition.

Use information from **Figure 5** to support your answer.

[2 marks]

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0 6 . 4 Cytochrome c is a protein.

The amino acid sequence of cytochrome c can be used to measure how closely related two species are.

Human cytochrome c contains 104 amino acids.

Scientists compared 22 of the amino acids found in cytochrome c in a range of organisms and recorded the number of differences from human cytochrome c.

The results are shown in **Table 4**.

Table 4

Organism	Number of amino acids different from human cytochrome c
A	3
B	3
C	5
D	6
E	10
F	11

A student looked at these data and concluded that organisms A and B are the most closely related.

Evaluate this conclusion.

[3 marks]

7

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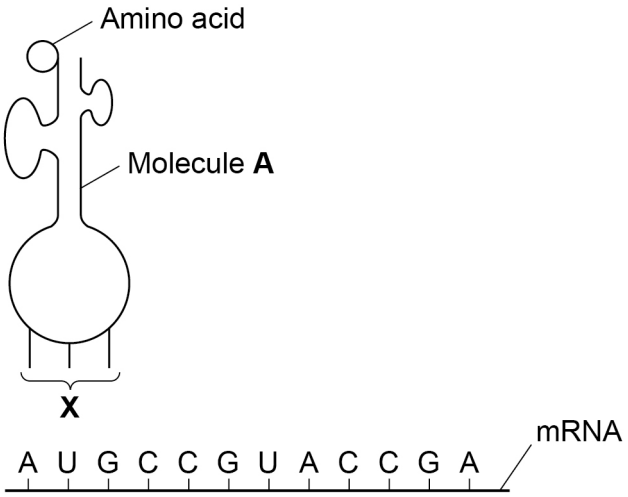
0 7 **Figure 6** shows one of the stages of protein synthesis.

Figure 6



0 7 . 1 Name each of the following:

[2 marks]

Molecule **A** _____

The part of molecule that is labelled **X** _____

0 7 . 2 Give the DNA base sequence that produced the mRNA strand shown in **Figure 6**.

[1 mark]

_____

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0 7 . 3 **Table 5** shows some of the mRNA codons for some amino acids.

Table 5

Codon	Amino acid
CCG	Proline
UGC	Cysteine
UAC	Tyrosine
AUG	Methionine
CGA, CGU	Arginine
GCC, GCU	Alanine
GUA	Valine
ACC, ACU	Threonine
GAC	Aspartate

Give the amino acid sequence translated from the mRNA strand shown in **Figure 6**.

Use information from **Table 5**.

[1 mark]

0 7 . 4 A different mRNA strand did not contain the base sequence GCC. The protein it translated contained the amino acid alanine.

Explain how this is possible.

[2 marks]

Do not write outside the box

0 7 . 5 **Table 6** describes some of the events occurring during different processes in a cell.

For each process, put a tick (✓) in the box if the statement is correct.

[3 marks]

Table 6

Statement	Process		
	DNA replication	**Transcription**	**Translation**
DNA double helix unwinds			
A polynucleotide chain is formed			
Peptide bonds are formed			

0 7 . 6 A chemical called oligomycin prevents respiration. Protein synthesis does not happen in cells treated with oligomycin.

Suggest why.

[3 marks]

12

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0 8 Read the following passage.

Microscopes are important tools in the study of cells.

Optical microscopes use light rays. The light rays pass through a specimen and are focused by the objective lens and eyepiece lens to produce an image.

Electron microscopes can be used to observe much smaller objects than optical microscopes. There are two types of electron microscope: the scanning electron microscope (SEM) and the transmission electron microscope (TEM).

Electron microscopes have a higher magnification and a higher resolution than optical microscopes. Electron microscopes can magnify up to × 2 000 000, optical microscopes can magnify up to × 2 000. A TEM has a resolution of up to 0.1 nm, a SEM has a resolution of up to 20 nm and an optical microscope has a resolution of about 0.2 μm.

The method to prepare a specimen for the electron microscope is complicated and the resulting image may contain artefacts.

Use information from the passage and your own knowledge to answer the questions.

0 8 . 1 What is meant by resolution (line 8)?

[1 mark]

0 8 . 2 Explain why electron microscopes have a higher resolution than optical microscopes (lines 8 – 12).

[2 marks]

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0 8 . 3 Calculate how many times higher the resolution of a TEM is than the resolution of an optical microscope (lines 9 – 12).

[1 mark]

0 8 . 4 Optical microscopes use lenses to focus light rays (line 2).

What is used to focus on the specimen in an electron microscope?

[1 mark]

Do not write outside the box

0 8 . 5 For each of the following investigations, state which of the three types of microscope named in the passage should be used.

Give a reason for your choice.

[4 marks]

To observe the diffusion of a coloured pigment out of a cell.

Type _____

Reason _____

_____

_____

To measure the length of cristae in a mitochondrion.

Type _____

Reason _____

_____

_____

To observe the movement of chromosomes during cell division.

Type _____

Reason _____

_____

_____

To investigate the arrangement of proteins on the surface of the cell membrane.

Type _____

Reason _____

_____

_____

Question 8 continues on the next page

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0 8 . 6 Suggest the meaning of 'artefacts' (line 14).

[1 mark]

10

END OF QUESTIONS

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